PROGRESS REPORT NO. 10

KINETICS OF OXIDATION AND QUENCHING OF COMBUSTIBLES IN EXHAUST SYSTEMS OF GASOLINE ENGINES

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PERIOD: December 1, 1969 to December 31, 1969

DECEMBER 1969

This project is under the technical supervision of the:

Coordinating Research Council
APRAC-Cape 8-68 Steering Committee

and is work performed by the:

Department of Mechanical Engineering
The University of Michigan
Ann Arbor, Michigan

Under Contract No. CAPE-8-68(1-68)-CRC
and Contract No. CPA-22-69-51-HEW

LONG-RANGE OBJECTIVES

It is well-known that a significant amount of CO and unburned fuel may be consumed in the exhaust system of gasoline engines. Such combustion phenomena in exhaust reactors may be used to advantage to reduce the emission of these undesirable constituents. This process is the basis of exhaust air injection systems currently installed on some automobiles.

The overall objectives of this three-year research program are:

- To determine the chemical and physical processes which affect the emission characteristics of exhaust reactors installed on selected typical engines operating at various conditions on a dynamometer test stand.
- To identify the chemical species and significant chemical reactions present before, within, and after the reactor.
- To obtain information which will be helpful in predicting the design of the next generation of gasoline engine exhaust reactors.

PHASE I PROGRESS

Progress this month has been primarily on the two tank exhaust reactor system to be used for measuring kinetic data. Design of the two tank single cylinder exhaust reactor system has been completed and fabrication is in progress at Walker Manufacturing Company. The system is sketched in Figure 1. Hot exhaust gas will pass from the exhaust port through a perforated tube and into a 1350 cu in. surge and mixing tank and then through a nozzle and into the 50 cu in. reactor. The high velocity jets generated by the nozzle will be used to keep the reactor well stirred. The reactor nozzle may be easily

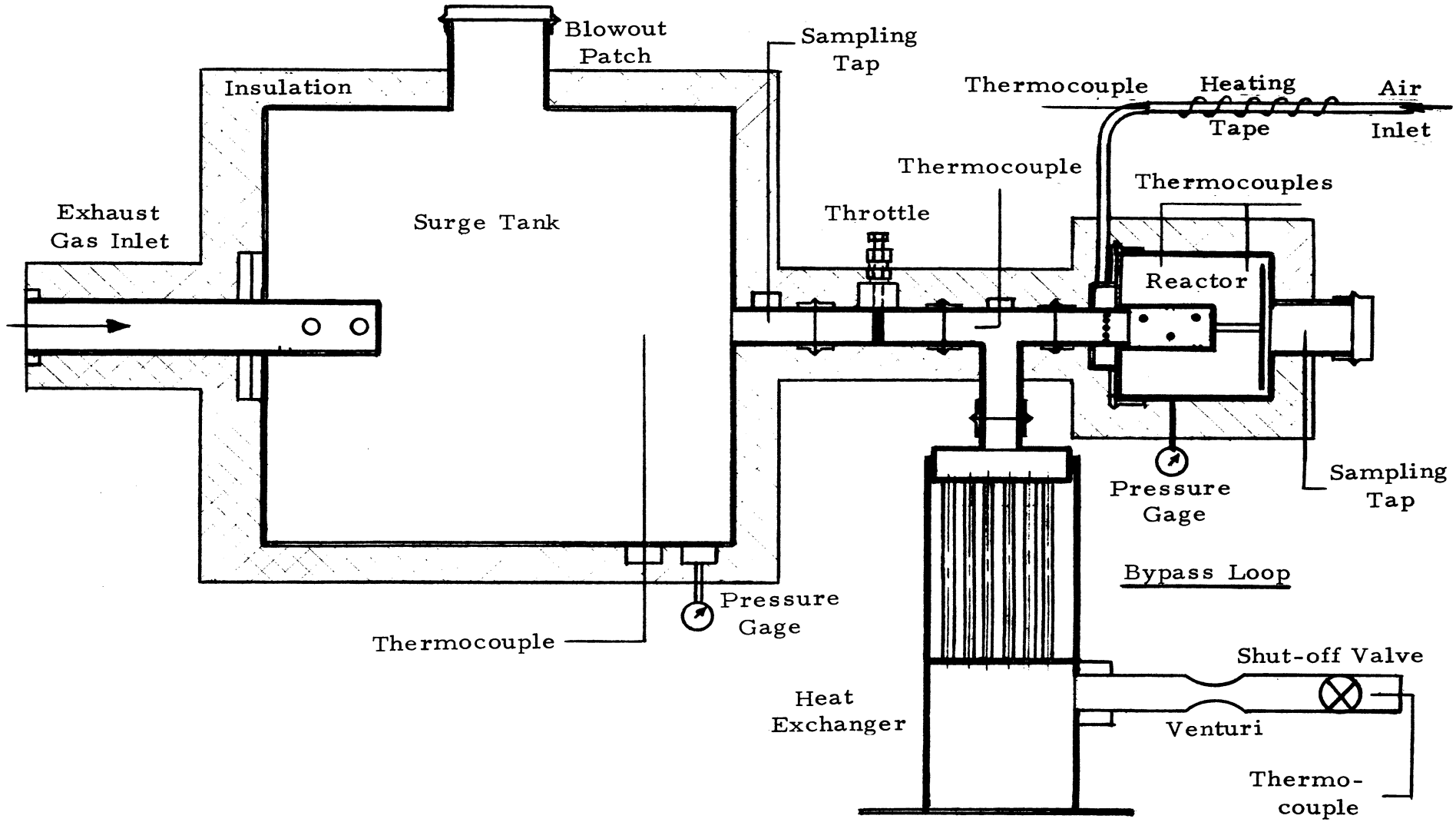


Figure 1. Single cylinder reactor system.

exchanged for an alternate design if substantial temperature or composition nonuniformities are found to exist inside the reactor. Air will be injected through a heated line at the reactor entrance. A throttle and bypass loop will be provided to vary the flow rate to the reactor without changing engine conditions. The two tanks and connecting piping will be constructed of Hastelloy-X and covered with ceramic fiber insulation, and should be capable of continuous operation at up to 2000°F.

Gas samples will be withdrawn at the reactor inlet and outlet through water-cooled sampling probes. Gas temperatures will be measured with shielded thermocouples in the surge tank, at the reactor entrance, at three locations inside the reactor, and at the bypass flowmeter. The degree of uniformity of temperature inside the reactor will be checked by comparing the three thermocouple readings. As a spot check the thermocouples can be moved around inside the reactor, and in addition the composition can be determined at various locations by inserting water-cooled sampling probes through the thermocouple taps. Surge tank and reactor pressures will be measured with manometers. Injection air flow rate will be measured with a critical flow orifice and temperature with a shielded thermocouple. Flow through the bypass loop will be measured with a Venturi meter after the gas has been cooled by passing through a heat exchanger.

PHASE II PROGRESS

Programming of the first generation model continues.

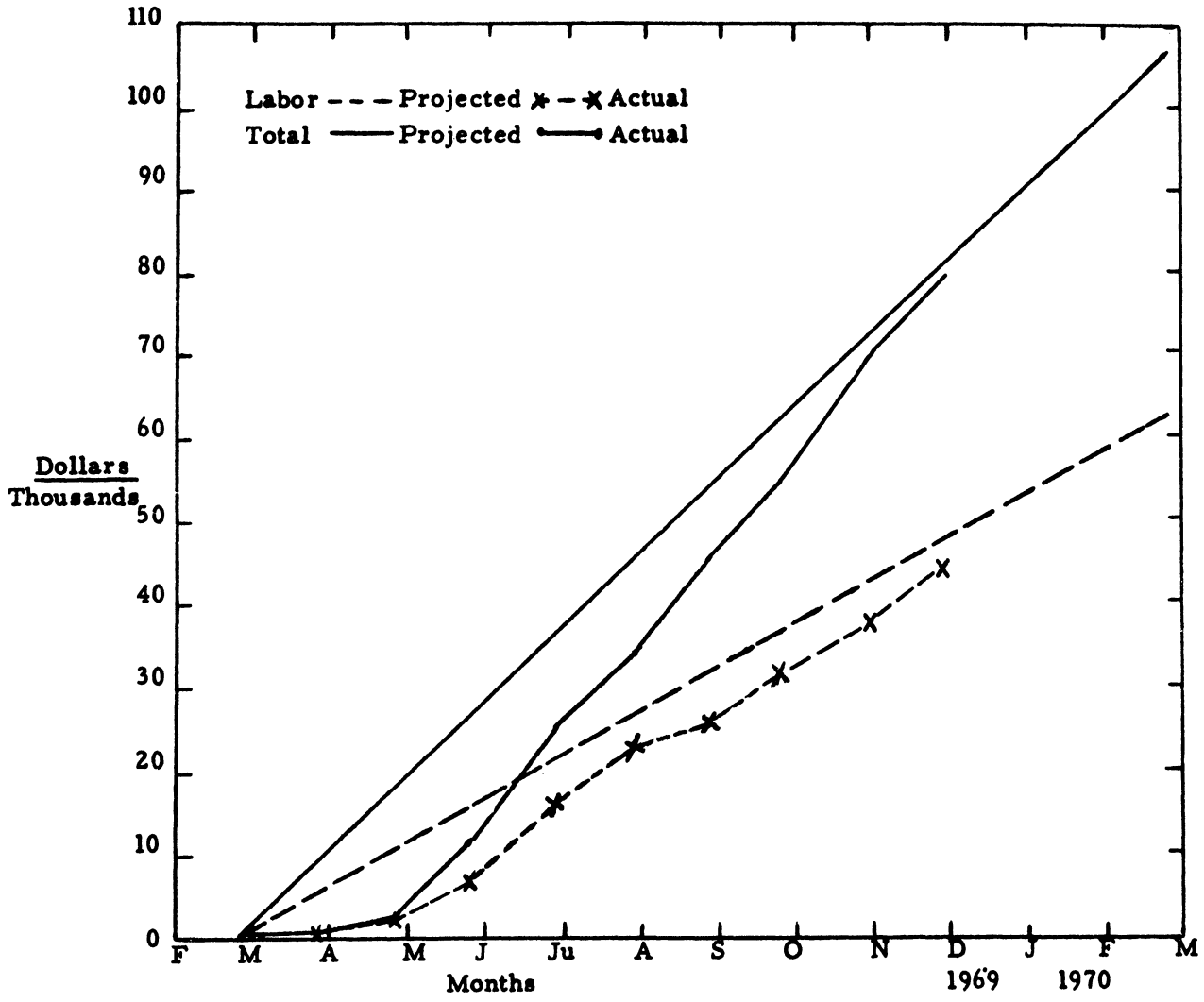
PHASE III PROGRESS

Work continues to separate the lighter hydrocarbons using the Perkin-Elmer 800 gas chromatograph.

CRC CAPE 8-68 PROGRAM

OVERALL FINANCIAL SUMMARY

Program Total: February 24, 1969 - February 23, 1970		$106,455
Cumulative Expenditures through November 24, 1969		79,279
	Balance	$ 27,176



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